

Effect of Potassium and Fiber Contains in Tomato (*Solanum Lycopersium L*) and Cucumber (*Cucumis Sativus L*) Juice to Lowering Blood Pressure of Hypertensive Patient at Primary Health Care Kebayoran Lama

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Keywords: Blood Pressure, Diet Modification, Hypertension, Tomato-Cucumber Juice.

Abstract: Hypertension is also a cause of death with 23.7% of the total 1.7 million deaths in Indonesia. Modification of food intake that contains high potassium, magnesium, and fiber, and low sodium is one of the alternative to reduce blood pressure (BP). The purpose of this study was to describe the effect of combination tomato-cucumber juice on lowering BP at Primary Health Care Kebayoran Lama in 2020. The quasi pre-experiment study was used as the study design with 30 patient of hypertension who have BP level >120/80 mmHg. The subject was divided into two groups consecutively (control and intervention group) to given the treatment. The intervention group received the juice made from 150g tomatoes and 100 g cucumber/day for 7 days. The result showed that there was a significant difference of systolic BP in the control ($p=0,003$) and intervention ($p=0,001$) group. The similar result revealed for diastolic BP between those group. Futhermore, the intervention group experienced higher lowering systolic and diastolic blood pressure compared to the control group significantly. Diet modification by giving combination juice (tomato and cucumber) as a treatment can be suggested by health professional for hypertensive patients on preventing complication disease caused high blood pressure.

1 INTRODUCTION

Hypertension is a condition when blood pressure is too high occurs chronically. According to the Joint National Committee 8 (JNC 8), hypertension is defined as systolic blood pressure (BP) level of ≥ 140 mmHg and/or diastolic BP level ≥ 90 mmHg. Systolic BP level <120 mmHg and diastolic BP level <80 mmHg is a normal blood pressure. Prehypertension is defined as the grey area falling between 120-139 mmHg systolic BP and 80-89 mmHg diastolic BP (James et al., 2014). Hypertension is one of the health problems worldwide because of its high prevalence. It continues to increase as a major risk factor for chronic heart disease, stroke, and chronic kidney disease (Singh et al., 2017).

An estimated 1.13 billion people worldwide have hypertension. At the global prevalence, hypertension prevalence is 22% and in the Southeast Asia is 25% including Indonesia (WHO, 2020). The number of people with hypertension is estimated to reach 1.5 billion individuals by 2025, with deaths reaching 9.4

million individuals. Basic Health Research (*Riskesmas*) 2013 resulted in prevalence hypertension at age 18 years in Indonesia reached 25.8%, which was diagnosed by health workers and/or have a history of taking medication is only 9.5%, indicating that most cases of hypertension in the community undiagnosed and reached by the team health services (Adrian & Tommy, 2019). DKI Jakarta as the capital city of Indonesia is ranked 5th as the city with the highest prevalence of hypertension reaching 10.47% (Kemenkes RI, 2018).

Hypertension remains one of the most important preventable contributors to disease and deaths. Many drugs related to reduce blood pressure are available. However, alternative and complementary treatment for blood pressure control is needed to reduce the high profile of side effects of anti-HT drugs (Wolak et al., 2019). This includes lifestyle modifications, especially dietary interventions such as consumption of more fruits and vegetables. Modification of food intake that contains high potassium, magnesium, and fiber, and low sodium is one of the recommendations

of the DASH diet (Dietary Approach to Stop Hypertension) to reduce risk factors for increasing blood pressure and prevent hypertension (Fung et al., 2010).

Several studies demonstrate that oral supplementation with tomato extract or tomato juice significantly decreases BP (Ilma&Wirawanni, 2015; Sabilu et.al., 2017). There are strong antioxidants such as lycopene, β -carotene and the colorless carotenoids phytoene and phytofluene, in addition to a myriad of other active nutrients such as tocopherols and polyphenols from tomato products or extracts. The antioxidant is one of the mechanisms for the cardiovascular protective effect. Other study showed that cucumber has an impact to reduce blood pressure (Sharmen et al., 2012; Yanti et al., 2017).

Tomatoes' potassium and lycopene content can lower blood pressure by inhibiting renin release and increasing sodium excretion. Potassium content can increase intracellular fluid concentration so that blood pressure drops, so it tends to draw fluid from the extracellular part and lowers blood pressure due to the vasodilating effect of blood vessels.

Cucumber and tomato are the fresh vegetables that widely consumed by the people of Indonesia. Cucumber and tomato can grow and spread in various regions in Indonesia, so that it is easily obtained at affordable prices. Those vegetables also have a good nutritional content, especially a good source of minerals and vitamins to maintain health. However, based on the data in the preliminary study, hypertension patient is rarely consuming those vegetables. Thus, one of the major aims of the current work was to compare whether combination juice tomato-cucumber has an effect or not to lowering blood pressure on patient of hypertension at Primary Health Care Kebayoran Lama in 2020.

2 METHODS

The quasi pre-experiment with pretest-posttest control group design was approved by the Ethics Committee of Faculty of Health, UHAMKA No.03/20.09/0650. The study was conducted at Primary Health Care (PHC) or *Puskesmas* Kebayoran Lama, DKI Jakarta Province in 2020. The research subjects were thirty patients of hypertension consecutively booked during health service visits in PHC who meet the inclusion criteria from September to October 2020. The inclusion criteria of this study were: 1) hypertensive patient aged 18-45 years with no complication diseases such as diabetes mellitus, chronic heart disease, chronic kidney disease, etc., 2)

having systolic BP level of ≥ 120 mmHg and/or diastolic BP level ≥ 80 mmHg, 3) consume anti hypertension drugs routinely, 4) willing to be a subject of research. As long as the duration of intervention was given to the subject, then they failure to follow the full intervention will be excluded of this study. The subjects who fulfil the criteria of this study were divided into two groups, the control and intervention group.

The intervention group was given the treatment tomato-cucumber juice and the control group was given the placebo (simple syrup 0 calorie). The composition of tomato-cucumber juice consisted of blended fresh tomato 150-gram, cucumber 100-gram, 2-gram non-caloric sweetener and water 200 cc. The placebo contains 5ml non-caloric syrup in 250 ml water. The intervention was given for 7 consecutive days before breakfast (07.00 – 08.00 WIB). Informed consent was performed to the subject.

Information on age, gender, body mass index (BMI), nutrition intake, and blood pressure was assessed using a standard questionnaire and procedure. Systolic and diastolic BP was performed using sphygmomanometer digital. Intake of energy, sodium, potassium, magnesium, and fiber was assessed using 3 days 24-hour food recall non-consecutively during intervention. Data were analyzed using univariate and bivariate analysis. Wilcoxon-Rank test was used to describe the differences of blood pressure between pre-post treatments in both group. The test of significance two tailed with $p \leq 0.05$ was considered to be statistically significant. Mann Whitney test was used to see the differentiate between control and intervention group.

3 RESULTS

The age, gender, nutritional status of the subject was described in the table 1. The proportion of gender in the subject was similar between control and intervention group. Otherwise, the age of subject in the intervention group was 100% at the age of 35-45 years. According to BMI, the nutritional status in the control group was the opposite of the intervention group where more respondents who suffer overweight and obesity in the intervention group.

The Mann Whitney test was used to see the differences in the respondent's nutritional intake such as energy, sodium, potassium, magnesium, and fiber during treatment period. There were significant differences in potassium and fiber intake between the control and intervention group ($p < 0,05$). The results showed that the average intake of those nutrient in the

Table 1: Characteristics of respondent.

Characteristic	Control		Mean±SD/ Median (Min-Max)	Intervention		Mean± SD/ Median (Min-Max)	p-value
	n	%		n	%		
Gender							
Men	6	40		7	46,7		
Women	9	60		8	53,3		
Age							
18-24 years	1	6,7		0	0		
25-34 years	4	26,7		0	0		
35-45 years	10	66,7		15	100		
BMI							
Normal	9	60		6	40		
Overweight-obesity	6	40		9	60		
Intake of Energy							
Defisit	2	13,3	2125,5 (1592,6 – 3494,3)	5	33,3	2048,3 ± 383,6 kkal	0,855
Normal	12	80,0	kkal	9	60,0		
Excess	1	6,7		1	6,7		
Intake of Natrium							
Defisit	12	80	1351,7 (1151,8–1973,8)	8	53,3	1491,1 ± 179,9 mg	0,057
Normal	3	20	mg	7	46,7		
Intake of Kalium							
Defisit	15	100	624,13 ± 403,2 mg	15	100	1106,3(541,9 - 2193) mg	0,017*
Normal	-	-		-	-		
Intake of Magnesium							
Defisit	15	100	48,3 ± 19,4 mg	15	100	36,4 (19,6 – 90,9) mg	0,145
Normal	-	-		-	-		
Intake of Fiber							
Defisit	14	93,3	10,7 (4,13 – 44,5) g	15	100	14,8 ± 3,34 g	0,000*
Normal	1	6,7		-	-		

* Wilcoxon-Rank Test, significantly difference (p<0,05)

intervention group was higher (1106,3 mg for potassium and 14,8 g for fiber) than the control group (624,1 mg for potassium and 10,7 g for fiber). However, the intake of micronutrients that have been scientifically proven to lower blood pressure is still below the recommended dietary allowances (Kalium: 2400 mg). It concludes that the subject of this research have poor eating habits in daily routine to manage their health.

Table 2 shows the result of blood pressure (BP) level in the two groups before and after treatment. The average systolic BP in the control group of this study before treatment was 143 (131-193) mmHg and 152,9±13,9 in the intervention group, whereas the diastolic BP was 89 (77-121) mmHg in the control group and 93,7±6,7 mmHg in the intervention group. Based on the JNC 8 classification, the subjects are classified as hypertension stage 1.

The main result of this study was that there is a significant difference in systolic and diastolic BP of the two groups (control and intervention). Furthermore, the highest decrease was seen in the intervention group compared to control group consistently of both BP. The

Difference in the decrease in systolic BP was 9 mmHg of the control group while in the intervention group it was 16 mmHg. The similar result is shown in the diastolic BP, the difference in blood pressure reduction of 5.2 mmHg in the control group and 7.2 mmHg in the intervention group.

4 DISCUSSION

The Hypertension is a multifactorial disease caused by the interaction of various risk factors experienced by a person. This study revealed that the respondents are patient hypertension aged 18-45 years. The age variable in this study has tried to be controlled by not including the age above 45 years. Increasing age in humans causes physiological changes in the body, because aging is a progressive process that results in decreased physiologic function such as thickening of the uterine due to a build-up of collagen in the muscle layer. Hence, blood vessels constrict and become stiff starting at the age of 45 years (Buford, 2016).

* Wilcoxon-Rank Test, significantly difference (p<0,05)

Table 2: o Differentiate of Pre-post test blood pressure on control and intervention group.

Blood Pressure	Pre-test	Post-test	p	Difference
	Mean ± SD/Median (min-max)	Mean ± SD/Median (min-max)		
Control Group				
Systolic (mmHg)	143 (131-193)	134,9±4,3	0,003*	9 mmHg
Diastolic (mmHg)	89 (77-121)	85±3,6	0,0038*	5,2 mmHg
Intervention Group				
Systolic (mmHg)	152,9±13,9	132,6±13,5	0,001*	16 mmHg
Diastolic (mmHg)	93,7±6,7	86,4±4,4	0,001*	7,2 mmHg

In addition, there is also an increase in peripheral resistance and sympathetic activity and a lack of baroreceptor sensitivity (regulating blood pressure and the role of the kidneys, blood flow and glomerular filtration rate) (Zhongjie, 2015). However, in this study showed that hypertension can occur in any ages and there are other factors influenced the blood pressure.

Nutritional status was described by BMI in this study. Half of the respondents were classified as overweight-obesity (BMI>25.0 kg/m²). Obesity is a major risk for essential hypertension. It mainly increases tubular reabsorption to impair pressure natriuresis and cause volume expansion via the activation of the SNS (Sympathetic nervous system) SNS and the RAS (Renin-angiotensin system) (Aronow, 2017). There is a mechanism for blood pressure reduction with weight loss in overweight hypertensive persons. A person who reduces calories without reducing sodium intake can reduce sympathetic activity caused by decreased RAS activity, natriuresis, and contraction of plasma volume. It can increase the blood pressure (Aronow, 2017; Palmer and Williams, 2016).

Dietary intakes play an important role in increasing blood pressure in this study. The main finding of this study showed that there was a significant effect of tomato-cucumber juice in lowering blood pressure. In line with previous studies, this indicated that systolic BP was decreased after consuming the treatment of tomato (Ilma and Wirawani, 2015; Wolak et al., 2019) and cucumber juice (Lebalado dan Mulyati, 2014; Ilma and Wirawani, 2015; Yanti et al., 2017). Cucumber has hypotensive and diuretic effect that decreases the volume of the fluid in the bloodstream. It can reduce the workload of the heart. Potassium, magnesium, and fiber contained cucumber have a role in maintaining the stability of the body.

The explanation of tomato can reduce blood pressure that is the active nutrients in the tomato (e.g., lycopene, phytoene, and Phyto fluence).

Bioflavonoids can increase the level of endothelial nitric oxide synthase (eNOS). The eNOS have a function in the formation nitric oxide (NO). NO is released from endothelial cells into vascular smooth muscle cells to reduce the tension (Sharmin et al., 2012; Yusuf et al., 2017). Because there are receptor substances, such as acetylcholine, bradykinin, serotonin circulates in the blood. The concentration of intracellular cyclic guanosine monophosphate and induce vascular smooth muscle relaxation can cause the vasodilatation of the capillaries. It is the role of NO when emerged condition in the body. Vasodilatation of the capillaries can reduce total peripheral resistance and blood pressure (Houston, 2011; Yusuf et al., 2017).

Cucumber contains a magnesium, which in addition to potassium content, can lower blood pressure by improving blood flow, relaxing the heart muscle, and calming nerves. A variety of cardiovascular diseases and disorders have been linked to fiber consumption. The main soluble fiber component of oat grains, β -glucan, was initially linked to a decrease in plasma cholesterol. Cholesterol-lowering therapy has been shown to reduce arterial stiffness in hypercholesterolemic patients and may thus be beneficial in blood pressure (Aleixandre and Miguel, 2016).

5 CONCLUSIONS

Consuming adequate portions of potassium can increase its concentration in the intracellular fluid so that it tends to draw fluid from the extracellular space and lowers blood pressure. Therefore, diet modification can be suggested by personal health such as nutritionist as the alternative treatment for hypertensive patient. Tomato and cucumber are available and affordable food to consume.

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